DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

WATER QUALITY CONTROL MANAGEMENT PROGRAM
ANNUAL REPORT
FISCAL YEAR 1999

JANUARY 2000

FOREWORD

While the New England office of the Corps was an independent division, regulations required us to submit an annual water quality report to the Chief of Engineers in Washington, D.C. When the New England office became a district under North Atlantic Division (NAD) in 1997 the annual reporting requirements changed. We prepare and send information to NAD that they use to prepare the required report to Washington. While we are no longer required by regulation to prepare an annual report in this format, we continue to do so because it meets our needs for recording and reporting what happened during the year.

This Fiscal Year 1999 Annual Water Quality Report of the New England District is a continuation of reports that began in 1978. Information contained herein updates that presented reports prepared through FY98. Duplication of previous information has been kept to a minimum.

Mr. Townsend Barker of the Water Management Section prepared this report and is available to provide additional information on areas of further interest (telephone: 978-318-8621).

NEW ENGLAND DISTRICT
WATER QUALITY CONTROL MANAGEMENT
ANNUAL REPORT
FISCAL YEAR 1999

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

FIGURE

NEW ENGLAND DISTRICT
WATER QUALITY CONTROL MANAGEMENT PROGRAM
ANNUAL REPORT
FISCAL YEAR 1999

1. GENERAL BACKGROUND

NAE has completed 35 dams, 5 hurricane barriers, and 93 local protection projects within the New England area. Figure 1 shows locations of the dams. In addition, NAE has acquired flowage rights on more than 8,000 acres of floodprone Massachusetts lands within the Charles River Natural Valley Storage area. All local protection projects, four dams, and three hurricane barriers have been turned over to local interests, and the remainder are operated and maintained by NAE. Most construction prior to 1955 was authorized for flood control purposes only; however, approval has been given for other uses at many of NAE's older reservoirs, due to development of new water resource needs in the basins. Most of the newer projects have been designed for more than flood control storage, e.g., recreation, conservation, and low flow augmentation; furthermore, Littleville and Colebrook River Lakes have significant water supply storage. Hydropower facilities have been constructed at seven sites on Corps-owned lands; however, these are designed, built, operated, and maintained by private interests not connected with the Corps.

Although water quality management is not a defined purpose at any project operated and maintained by NAE, the Corps has a long-standing, strong interest in water quality. Executive Order 11752, "Prevention, Control, and Abatement of Environmental Pollution at Federal Facilities," 19 December 1973, makes it a stated national policy that the Federal Government, in the design, construction, and operation of its facilities, shall provide leadership in the nationwide effort to protect and enhance the quality of our air, water, and land resources. Section 102b, of the Federal Water Pollution Control Act Amendments of 1972 places responsibility with EPA for determination of the need for, the value of, and the impact of storage for water quality control in reservoir projects constructed after 1972. Responsibility for water quality management at Corps projects, however, clearly rests with the Corps since it is an integral part of our

water control management activities. To meet this responsibility,
area-wide water quality management programs must be estab-

NED RESERVOIR PROJECTS INCLUDED IN ITS
WATER QUALITY MANAGEMENT PROGRAM

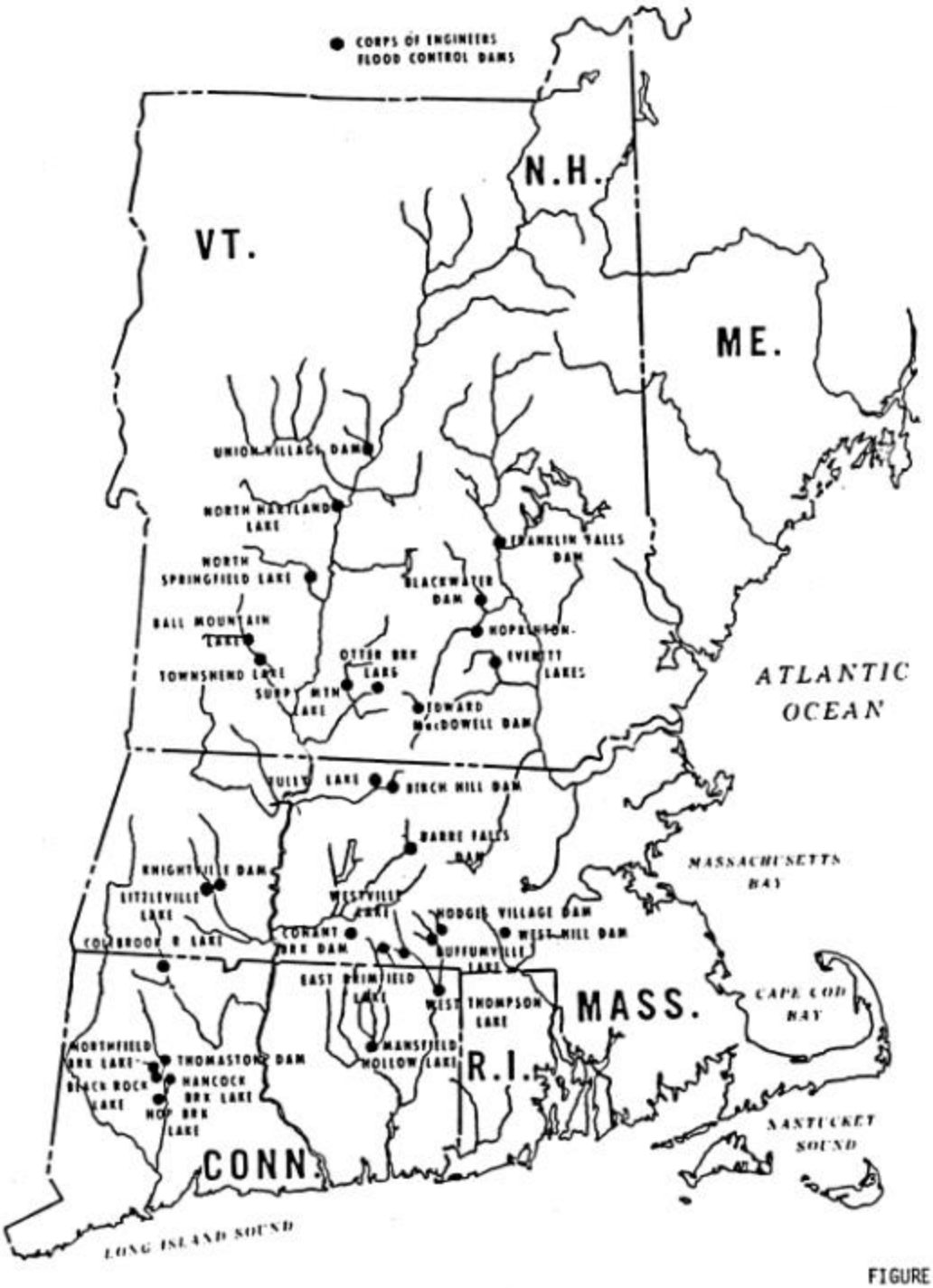

FIGURE 1

lished, specific water quality objectives for each reservoir area-wide water quality management programs must be established, specific water quality objectives for each reservoir project developed, and procedures implemented to meet these objectives. To ensure success, continual collection and evaluation of water quality data and reporting of water quality management activities are necessary. The Annual Water Quality Reports, required of each Corps Division, are part of that program of evaluation and reporting.

NAE's reservoir water quality control management program has multiple goals. Its primary purpose is to protect public health and safety, but additional goals include meeting State water quality standards, maintaining water quality suitable for all project purposes, and understanding the effects of project operations on water quality. The Master Water Control Manual for each basin includes the goals and objectives for the water quality program.

This annual report is a summary of water quality conditions and activities during the year. In addition to meeting reporting requirements of NAD, it is a valuable tool for reviewing the past year's program and charting the course for the following year. This report is not limited to activities under the Corps Reservoir Water Quality Operations and Maintenance Program, but includes other Corps water quality activities and concerns related to various studies, investigations, and designs.

2. SUMMARY

The FY99 (1 October 1998 through 30 September 1999) NAE reservoir water quality control management program was similar to that presented in the FY98 Annual Water Quality Report (AWQR). Total program size was equal to $254,000, a decrease of about 4 percent from the previous year. No changes were made in the basic structure of NAE's classes I, II, and III water quality classification system (described in Appendix A). The water quality team formed in 1982, with representatives from Engineering/Planning and Construction/ Operations Divisions continued setting direction for the overall water quality program and coordinated all its elements.

FY99 had a cool wet spring followed by a very dry summer, including literally no rain at many projects during the entire month of June. Unusually dry summer conditions resulted in few beach closings. The beach at Union Village Dam in Vermont continued to be closed frequently because of high bacteria counts; the source has not been identified but does not appear to be weather related. Low flow conditions meant Thomaston Dam in Connecticut was not able to store enough for effective low flow augmentation during July and August. Low flow conditions are conducive to algal blooms, and a minor one occurred at Hop Brook Lake in Connecticut. Wet conditions in the spring may have contributed to the record number of Atlantic salmon returning to the West River in Vermont.

Water quality was good to excellent at most projects with concerns generally caused by external phenomena, such as upstream nonpoint source discharges or acid precipitation. By "good water quality" we mean the water generally met or exceeded State standards, and was suitable for its intended uses, which at most projects was recreation, and fish and wildlife habitat. Table 1 contains current NAE classifications of existing reservoir projects; changes from FY98 include moving Edward MacDowell, Everett, Littleville and Westville Lakes from class II to I to reflect general improvements in water quality over time. State water quality classifications are listed in Appendix B.

Activities performed by NAE in FY99 under the Reservoir Water Quality Operation and Maintenance Program included

- Potable water and bathing beach water quality monitoring.

- Baseline monitoring of class III and II projects without conservation pools.

- Continuation of the study of the relationship between rainfall and elevated bacteria counts at beaches.

- Completion of reports on the French River and West Hill Dam priority pollutant scans.

- Study of phosphorus sources to North Hartland Lake.

- Investigation of an algal bloom at Hop Brook Lake in late July.

TABLE 1
NAE RESERVOIR PROJECT CLASSIFICATION
1 JANUARY 2000

Class III	Class II	Class I
Five projects with definite water quality problems.	Six projects with minor water quality problems.	Seventeen projects with no significant water quality problems.
Three Lakes	**Five Lakes**	**Thirteen Lakes**
Hop Brook, CT	North Hartland, VT	Ball Mountain
Northfield Brook, CT	Hopkinton, NH	North Springfield, VT
West Thompson, CT	Buffumville, MA	Townshend, VT
	East Brimfield, MA	Edward MacDowell, NH
	Tully, MA	Everett, NH
		Otter Brook, NH
		Surry Mountain, NY
		Littleville, MA
		Westville, MA
		Black Rock, CT
		Colebrook River, CT
		Hancock Brook, CT
		Mansfield Hollow, CT
Two Dry-Bed Reservoirs	**One Dry-Bed Reservoir**	**Seven Dry-Bed Reservoirs**
Union Village, VT	Thomaston, CT	Blackwater, NH
Birch Hill, MA		Franklin Falls, NH
		Barre Falls, MA
		Conant Brook, MA
		Hodges Village, MA
		Knightville, MA
		West Hill, MA

Water quality activities performed in FY99 as part of other studies, investigations, and designs included

- Completion of water quality portions of environmental assessment for 5 NAE reservoir projects.

- Angler surveys at 4 NAE reservoir projects.

- Completion of a final report on the Cohasset, Massachusetts watershed study.

- Monitoring of conditions at Thomaston Dam, Connecticut, during augmentation of flow in the Naugatuck River.

- Water quality monitoring at the Town Brook tunnel.

- Initiation of a habitat restoration study at Parker Pond in Massachusetts.

- Initiation of a study on the use of Turner Reservoir in Rhode Island for public water supply.

- Initiation of the Rhode Island salt pond restoration feasibility study.

Water quality personnel at NAE continued coordinating with Federal, State, and local officials regarding mutual water quality concerns. In an effort to promote information exchange, copies of this report are being provided to relevant State and Federal agencies and interested private parties.

Appendix C contains a summary of reservoir water quality control management reports.

3. RESERVOIR WATER QUALITY OPERATION AND MAINTENANCE PROGRAM

a. Water Quality Team. NAE's water quality team, established in 1982 with members from Engineering and Operations Directorates, continued functioning smoothly in 1999. Regular meetings throughout the winter and early spring enabled the team to plan the 1999 reservoir water quality program. Additional meetings during the summer

and fall as needed coordinated the ongoing program. Mr. Bruce Williams of Technical Services Branch represented Construction/Operations, Mr. William Hubbard, Chief Environmental Resources Section represented Planning, and Mr. Townsend Barker of the Geotechnical and Water Management Branch continued as Engineering's representative and chaired the team. Table 2 contains a summary of experience levels of members of the water quality team, and the principals involved in carrying out the water quality programs.

b. Potable Water Quality Monitoring. NAE monitors 50 drinking water wells at 24 reservoir projects on a regular basis. In accordance with requirements of the Environmental Protection Agency's "Total Coliform Rule," sampling frequency is based on expected monthly usage as predicated from past records. Biweekly, monthly, or quarterly samplings are called for during the recreation season. Drinking fountains at NAE's recreation areas are open from approximately the third Saturday in May to the weekend after Labor Day. Monitoring could vary on a monthly basis according to the actual number of visitors expected. However, for simplicity's sake, sampling at each project, during the recreation period, was set according to the expected maximum monthly attendance for the year. During the remainder of the year, wells kept open for project personnel are monitored quarterly. Monitoring for other parameters is performed as required by the States where the wells are located. Table 3 contains a summary of the projects, by state, where NAE monitors potable water quality.

NAE samples the wells, but bacteria analyses are performed by contract laboratories. Laboratories used included Alpha Analytical Labs in Westborough and Microbac in Clinton for Massachusetts samples, Biological Services in Keene and Eastern Analytical in Concord for New Hampshire, Aquacheck Water Testing Laboratory, in Weathersfield for Vermont, and Northeast Laboratories Inc. in Berlin for Connecticut samples.

Drinking water standards require less than one total coliform bacterium per 100 ml. Wells showing possible contamination are closed, chlorinated, flushed, and retested. If retesting shows the well to be safe, it is reopened. However, wells may also be closed for other

reasons, including excessive turbidity or noncoliform bacteria.

Wells at West Thompson Lake in Connecticut and Ball Mountain and Townshend Lakes in Vermont had unacceptable levels of coliform bacteria during one sampling each in FY99. Retesting after chlorination showed safe conditions, and none tested positive for E. coli. Total coliforms are commonly found after work has been performed on the wells or water lines,

TABLE 2
WATER QUALITY STAFF

EMPLOYEE	SECTION	POSITION TITLE	GRADE	YEARS OF EXPERIENCE	AREAS OF EXPERTISE
Barker, T.*	Water Management	Hydraulic Engineer	GS-12	25	Water chemistry, computer modeling, environmental engineering, hydrologic engineering
Geib, M.	Water Management	H&H Team Leader	GS-13	23	Technical review, hydrologic engineering, computer modeling
Hubbard, W.*	Environmental Resources	Environmental Resource Specialist	GS-13	21	Aquatic ecology, benthic interactions, habitat restoration, environmental regulations
Levitt, K.	Environmental Resources	Biologist	GS-11	16	Fisheries biology, limnology, aquatic microbiology
McNally, N.*	Water Management	Physical Science Technician	GS-9	13	Sample collection, HTW
Miller, K.	Water Management	Chemist	GS-11	9	Chemistry, sample collection
Sullivan, H.	Water Management	Hydraulic Engineer	GS-11	7	Environmental engineering, computer modeling, hydrologic engineering
Trinchero, P.	Environmental Resources	Biologist	GS-11	27	Fisheries biology, lymnology, aquatic microbiology, ecology
Williams, B.*	Operations Technical Support	Park Manager	GS-12	20	Wildlife biology, wetlands, environmental compliance and restoration
Wood, D.	Water Management	Hydraulic Engineer	GS-12	25	Environmental engineering, computer modeling, hydrologic engineering

*Primary participants in the reservoir water quality program.

and the system has not been thoroughly chlorinated and cleaned.

TABLE 3

POTABLE WATER QUALITY MONITORING
AT NAE RESERVOIR PROJECTS

	Wells Monitored
Vermont	
Ball Mountain Lake	6
North Hartland Lake	2
North Springfield Lake	3
Townshend Lake	3
Union Village Dam	2
New Hampshire	
Blackwater Dam	1
Edward MacDowell Lake	1
Everett Lake	1
Hopkinton Lake	2
Otter Brook Lake	2
Surry Mountain Lake	2
Massachusetts	
Barre Falls Dam	2
Birch Hill Dam	1
Buffumville Lake	2
Knightville Dam	3
Littleville Lake	1
Tully Lake	2
West Hill Dam	4
Connecticut	
Colebrook River Lake	1
Hop Brook Lake	4
Mansfield Hollow Lake	1
Northfield Brook Lake	2
Thomaston Dam	2

The well at the Upper Connecticut River Basin office at North Springfield Lake in Vermont repeatedly tested positive for total coliforms in June and July. Testing at different points in the line indicated the problem originated in the well or very close to it. After being thoroughly chlorinated, the system finally tested safe, and has continued to do so.

In May, after work was performed on the PVC lines between the well and the drinking fountain at the Knightville Dam campground, a citizen reported to the Massachusetts Department of Health that the water "tasted like kerosene." The lines were flushed and the water was tested, at the State's request, for organic contamination. None was found and the system was reopened to the public.

c. Bathing Beach Water Quality Monitoring. Swimming areas at 13 NAE reservoirs were operated by the Corps in 1999, including the new beach opened at Edward MacDowell Lake in New Hampshire in FY99. Table 4 contains a summary of projects, by State, where water quality for bathing is monitored by NAE.

Beaches maintained by NAE are monitored biweekly during the recreation period which runs from about the third weekend in May until Labor Day. Experience has shown that bacteria counts tend to rise after rainstorms. Consequently, in 1994, NAE began extra monitoring of selected projects following rainstorms, to develop a database for predicting how long beaches need to be closed. This was particularly important in Connecticut because the required *Enterococcus* test takes two days.

Based on results from the study of bacteria counts after rainstorms, we began administrative closures of beaches at Hop Brook and Northfield Brook Lakes in Connecticut in 1997. This is explained in more detail in paragraph 3e, but briefly, the beaches were closed when rainfall at the projects met certain conditions, without waiting for actual bacteria counts.

The openings of beaches at Hop Brook and Northfield Brook Lakes in Connecticut and West Hill Dam in Massachusetts were delayed because of findings of high

bacteria counts in the initial samplings. However, by the beginning of June, all beaches were open except for Hop Brook Lake, which didn't get a clean bill of health until late June.

TABLE 4

BATHING BEACH WATER QUALITY MONITORING
AT NAE RESERVOIR PROJECTS

	Locations Monitored
Vermont	
Ball Mountain Lake	1
North Hartland Lake	1
North Springfield Lake	1
Townshend Lake	1
Union Village Dam	1
New Hampshire	
Edward MacDowell Lake	1
Hopkinton Lake	1
Otter Brook Lake	1
Surry Mountain Lake	1
Massachusetts	
Buffumville Lake	1
West Hill Dam	1
Connecticut	
Hop Brook Lake	1
Northfield Brook Lake	1

High bacteria counts normally occur at beaches only after rainstorms, and the exceptionally dry summer had few beach closings, and most of those occurred following May storms, before the rain stopped in June. Beaches at Hop Brook, Northfield Brook and North Hartland Lakes and West Hill Dam were closed one or more days in May, and the beach at Buffumville Lake was closed in July following a

heavy thunderstorm. The only other beach closings were at Union Village Dam.

The beach at Union Village Dam was repeatedly closed due to high bacteria counts in 1999. This appears to be a continuation of an unsolved problem that began during the second half of the summer of 1997. The mostly likely source of these counts is a failing domestic septic system, but sampling at many points along the river and tributaries by the Corps and the local Board of Health have yet to locate it. This project will be carefully watched in 2000.

Beach monitoring in FY00 is expected to be the similar to that in FY99 with biweekly monitoring of all projects, supplemented with additional sampling following heavy rain.

d. Baseline Fixed Station Monitoring. In order to use resources efficiently, while meeting requirements to monitor water quality trends and changes at Corps projects, NAE splits its baseline water quality program into high and low level monitoring. Briefly, the difference between these two levels is in the statistical certainty of results. High level baseline monitoring involves a higher level of statistical certainty, and a larger number of samples than low level monitoring. The NAE Annual Water Quality Report for 1990 contained a detailed explanation of the statistical basis used for selecting sampling frequency for water quality monitoring at NAE projects.

Low level baseline monitoring was performed in 1999 at the one class II project without a conservation pool: Thomaston Dam in Connecticut. Baseline data collection was last performed at this project in 1996; additional monitoring was needed to monitor trends and check for changes in water quality conditions. Class II projects are those with only minor water quality problems, and enough data have been collected over the years so that annual monitoring is not required. Typically at class II projects, 2 to 4 stations are sampled three times from April through September.

At Thomaston Dam, 3 stations were sampled three times from April through September. Parameters analyzed

included field parameters (DO, pH, temperature, conductivity, turbidity), nutrients (ammonia, nitrite plus nitrate, total phosphorus), indicator organisms (*Enterococci* in Connecticut) and the trace metals aluminum and mercury, which have shown up in the past and for which there are concerns.

High level baseline monitoring was performed in 1999 at the class III projects without conservation pools. Class III projects are those with continuing water quality problems, and receive more frequent and intensive sampling than class I or II projects. In 1999 there were two class III reservoir projects without conservation pools: Birch Hill Dam in Massachusetts and Union Village Dam in Vermont. Baseline data was last collected at these projects in 1997. Samples were collected from inflow, discharge, and additional stations six times from April through October. Parameters analyzed included field parameters (DO, pH, temperature, conductivity, turbidity), nutrients (ammonia, nitrite plus nitrate, total phosphorus), indicator organisms (fecal coliforms in Massachusetts and *E. coli* in Vermont) and trace metals.

Data collected in 1999 at these projects will be used to update their respective water quality reports. This work is scheduled for later in fiscal year 2000.

e. Beach-Rainfall Study. In 1999 NAE continued its study of the relationship between rainfall events and high bacteria counts at beaches, to further develop administrative closure protocols. This study began in 1994 because NAE was concerned its beach monitoring program was not providing a good means to determine when beaches should be open or closed. Typically, beaches are closed after a high bacteria count and reopened when counts are below the standard; however, because of delays in getting results, beaches may be opened when they should have been closed, and closed after the danger has passed. High bacteria counts are usually related to rainfall, but NAE lacks the resources to sample all beaches every time it rains. Consequently, NAE began a study to determine when beaches should be opened and closed based on rainfall at four of NAE's most popular projects -- Hop Brook and Northfield Brook Lakes in Connecticut, Townshend Lake in Vermont, and Surry Mountain Lake in New Hampshire. At

these projects, samples were collected for several days after heavy rainfall events during the recreation season.

Administrative closure protocols were developed and implemented at Hop Brook and Northfield Brook Lakes, but additional data were required to develop a useable protocol at Townshend Lake. Otter Brook Lake was dropped from the program because the relationship between rainfall and beach bacteria appeared to be too complex to allow development of an administrative closure plan. This was not a major setback, however, because beach closures at Otter Brook are much less frequent than at Hop Brook or Northfield Brook Lakes.

In 1998 the beach at West Hill Dam in Massachusetts was added to take the place of Otter Brook Lake in this study. Hop Brook Lake was dropped because it did not appear that further study would refine the administrative closure protocol further, and Buffumville Lake in Massachusetts took its place. Northfield Brook Lake was retained because changes in its watershed due to sewering an area with problem septic systems meant that the beach closure protocol might need to be revised to be less strict.

The near complete lack of rainfall during the swimming season meant that very little information was collected in FY99. This study will continue during the 2000 recreation season, at the end of which six years of data will have been collected. These data and the study will then be evaluated for continuation, modification, or termination.

f. EPA Priority Pollutant Scans.

(1) General. Contaminants are an area of great concern to the Corps nationwide. In response to ETL 1110-2--281 "Reservoir Contaminants," many Corps Divisions have tested for the full range of EPA priority pollutants at all their projects. NAE began performing priority pollutant scans in 1987, when the NAE Lab achieved the ability to perform analyses for organic compounds on the priority pollutant list. Hopkinton Lake and Birch Hill Dam were the initial projects studied. NAE intends to perform similar scans at all projects eventually.

By the end of FY98, priority pollutant scans had been performed at most NAE projects. Efforts now are concentrating or analyzing results. Table 5 gives a summary of NAE reservoir projects where priority scans have been performed and the year samples were collected and analyzed.

(2) French and Blackstone Rivers. In FY99 NAE completed reports on priority pollutant scans at the two Corps flood control reservoir projects in the French River basin -- Hodges Village Dam and Buffumville Lake, and the one such project in the Blackstone River Basin – West Hill Dam. All of these projects are in Massachusetts. Samples collected from sediments in October 1995 at these projects were analyzed for metals, PCBs, pesticides, volatile and semi-volatile organic compounds, dioxins and furans, and TOC. Overall, levels of EPA priority pollutants at these projects were low and indicative of natural background conditions. Although some contaminants were found in concentrations high enough to have possible effects on sensitive benthic organisms, these effects would be minor, and no substances were in high enough concentrations to pose a risk to humans or interfere with uses of the projects and their waters. These findings were summarized in “French River Projects, Pollutant Scan,” January 1999; and “West Hill Dam Pollutant Scan,” April 1999.

TABLE 5

PRIORITY POLLUTANT SCANS
AT NAE RESERVOIR PROJECTS

	Year Samples Collected
New Hampshire	
Blackwater Dam	1998
Edward MacDowell Dam	1998
Everett Lake	1998
Franklin Falls Dam	1993
Hopkinton Lake	1987
Otter Brook Lake	1991
Surry Mountain Lake	1998
Massachusetts	

Barre Falls Dam	1993
Birch Hill Dam	1987
Buffumville Lake	1995
Conant Brook Dam	1998
East Brimfield Lake	1994
Hodges Village Dam	1995
Knightville Dam	1990
Littleville Lake	1990
Tully Lake	1998
West Hill Dam	1995
Westville Lake	1994
Connecticut	
Colebrook River Lake	1995
Hop Brook Lake	1991
Mansfield Hollow Lake	1993
Northfield Brook Lake	1989
Thomaston Dam	1991
West Thompson Lake	1993
Vermont	
Ball Mountain Lake	1996
North Hartland Lake	1996
North Springfield Lake	1996
Townshend Lake	1996

g. High Phosphorus at North Hartland Lake. Towards the end of FY97, indications of eutrophication were noticed in the upper reaches of North Hartland Lake in Vermont. Billowing clouds of the filamentous algae *Oedogonium* were in the water column and covering vegetation, indicating the lake was receiving excessive amounts of nutrients. While algae had not appeared in large numbers in the main part of the lake yet, they would if the phosphorus input is not controlled. We discussed these findings with Vermont, but the source of this high phosphorus was not identified. There probably is no one source of these nutrients, but rather they are a result the rapid and extensive development occurring in the watershed. As a check on this assumption, NAE began collecting extra samples upstream of the project in FY98. This sample collection was expanded to additional station locations in FY99, but the study has been greatly hampered by quality control problems at contract laboratories. All of the samples from FY98 and the initial samples from FY99

had to be discarded because they were ultimately determined to be contaminated by laboratory errors.

Algae growth was not as heavy in 1999 as was observed in 1998, probably because of effects of the summer drought on water quality; there was much less overland runoff, and almost all streamflow was from groundwater discharge. Sampling and coordination with Vermont will likely continue in 1999.

h. Algal Bloom at Hop Brook Lake. In late July, the project manager at Hop Brook Lake in Connecticut called requesting help identifying an algal bloom at the lake. This sounded ominous because the beach at this project gets more usage than any other in NAE, but this project was plagued in the past by very heavy algal problems. In previous years, the algal have been so thick as to give the appearance from a distance that the water was drained and the reservoir refilled with green paint. Such conditions, of course, required the closing of the beach. Fortunately, this was just the beginning of a bloom around the edges of the lake. Analysis of a sample showed it was the blue-green algae *Oscillatoria*. Blooms of this organism have a bright green color and can deplete oxygen levels at night resulting in fish kills, but does not produce toxins as some blue-greens do. The bloom did not strengthen significantly during the remainder of the summer, and in the end was not a problem. Heavy blooms have been rare since a shallow portion of the lake were dredged, removing nutrient rich sediments.

i. FY99 Reservoir Water Quality Concerns. NAE rated water quality at most of its reservoirs during FY99 as good to excellent, because it usually met State standards and was usable for its intended purposes. External phenomena including acid rain, urban runoff, wastewater treatment plant discharges, and natural watershed conditions were primary causes of water quality concerns. Corps project operations do not adversely affect water quality at any NAE reservoirs.

Table 6, a summary of water quality concerns at NAE projects in FY99, shows many projects with high levels of metals, color, nutrients, turbidity, and bacteria; and low levels of pH and DO. However, some things need explaining lest this table presents an unrealistically bad impression

of water quality conditions. What the table lists are water quality concerns--these are not necessarily all problems. For example, most metals listed have been found only rarely at levels above criteria necessary to protect aquatic life. Furthermore, these criteria were taken from the literature, not studies of project conditions and resident aquatic life. Only at Union Village Dam, Vermont, is there evidence of metals adversely affecting aquatic life, and the effects appear minor. Metals at Union Village Dam originate in acid mine drainage from abandoned copper mines upstream from Corps project boundaries. At the remaining NAE projects, metals appear to be the result of upstream wastewater discharges, or natural watershed conditions and effects of acid rain. Mercury is a concern at all NAE projects; however, mercury contamination of fish is a problem for all New England States, and large sections of the rest of the country. The widespread nature of the mercury problem is due to atmospheric deposition. Most color, iron, manganese, and some low pH levels originate in swamps and marshes in the watersheds. Acid rain is suspected of being responsible for very low pH levels. High nutrient levels originate primarily in agricultural runoff and wastewater treatment plant discharges. Erosion in watersheds, and algal blooms in reservoirs, are sources of high turbidity at NAE projects. Urban runoff, wastewater treatment plant discharges, and agricultural runoff produce high coliform bacteria counts. Low DO levels are due to natural watershed conditions and excessive algae and aquatic macrophyte growth.

j. Coordination with Other Agencies. NAE tries to coordinate its water quality program with the states and other interests; most of this coordination occurs through informal contacts. Available NAE water quality data on file is made available to all who request it. Results of drinking

TABLE 6

NAE RESERVOIR WATER QUALITY CONCERNS FY99

Project	Low pH	High pH	Low DO	High P	High N	High Color	High Turbidity	High Bacteria	High Metals	Other Concerns	Suspected Contributing Sources
Birch Hill, MA	X		X					X	Hg,Al	PCBs	WWTP discharges, Acid rain
Buffumville, MA	X	X	X	X						Aquatic weeds	WWTP discharges, Acid rain
East Brimfield, MA	X	X	X	X						Aquatic weeds	Swamps & marshes, Acid rain
Hop Brook, CT	X	X	X	X	X	X	X	X	Al,Hg	Algae blooms	Urban runoff, Farm runoff, Aci rain
Hopkinton, NH	X		X								WWTP discharges, Acid rain
Northfield Brk, CT	X			X	X			X	Hg	Algae blooms	Acid rain
North Hartland, VT		X		X	X		X		Hg,Al		WWTP discharges
Thomaston, CT									Hg, Pb, Al		WWTP discharges, Acid rain, Urban runoff
Tully, MA	X		X			X			Hg	Tannic acids	Swamps and marshes
Union Village, VT							X	X	Hg,Cd,Cu, Zn,Al,Fe	Acid mine drainage	Abandoned copper mines, Farm runoff
West Thompson, CT	X	X	X	X	X	X	X	X	Hg,Al, Pb	Algae blooms, Pest., Organics	WWTP discharges, Acid rain

water analyses are sent to the appropriate State agency within 24 hours. Beach analyses at New Hampshire projects are sent to the New Hampshire Department of Environmental Services monthly. Water quality monitor data from the Town Brook tunnel is sent to Massachusetts monthly. Copies of the Annual Water Quality Report are sent to State agencies in all six New England States, the U.S. EPA, and interested private organizations.

In April 1998, NAE participated in a meeting with Massachusetts and other federal agencies at the USGS office to discuss a statewide water resources monitoring program. Although the proposed program will have minimal impact on the Corps, NAE continued to coordinate with these other agencies in FY99.

As discussed in paragraph 4f, NAE participated in meetings of the Smelt Conservation Team, setup to monitor conditions at Town Brook in Quincy, Massachusetts.

NAE is working closely with the Massachusetts Executive Office of Environmental Affairs to address PCB contamination in sediments at Birch Hill Dam. This is discussed in paragraph 4b.

k. Continuing Water Quality Problems. There are five reservoir projects, operated and maintained by NAE, that have continuing water quality problems: Hop Brook, Northfield Brook, and West Thompson Lakes in Connecticut, Birch Hill Dam in Massachusetts, and Union Village Dam in Vermont. This section summarizes the problems, and how NAE is addressing them.

(1) Hop Brook Lake. This project has chronic high bacteria counts and algae blooms, causing the popular beach to be closed to swimming often. These problems originate in land-use practices outside the borders of Hop Brook Lake. Consequently, NAE has tried to involve State and local agencies in taking actions such as checking for failing septic systems, and helping farmers use good agricultural practices. Additionally, NAE is designing sedimentation basins on tributary streams to intercept suspended sediment containing the phosphorus that fuels algae blooms. Finally, because lake bacteria counts tend to rise after heavy rains, the relationship between runoff and bacteria levels has been studied, and protocols

developed to maximize the amount of time the lake can safely be open.

(2) Northfield Brook Lake. Bacteria counts at the popular beach at this small project tend to rise and fall quickly when it rains. Consultations with the local health department have indicated that the problem is not due to any particular source, but from the watershed in general, which is small, hilly, and generates runoff quickly when it rains. After studying the relationship between rainfall and beach bacteria counts, NAE developed and tested a beach closure protocol based on rainfall. NAE also adopted a new test for *Enterococci* that gives results within 24 hours, as a replacement for the standard test that takes 48.

(3) West Thompson Lake. This lake has severe annual algae blooms which look nasty and disrupt its ecosystem. NAE is continuing to gather data on sources of the excess phosphorus fueling these blooms. If, as suspected, the Southbridge wastewater treatment plant is the principal source, collected data will be presented to the State and EPA when that treatment plant's discharge permit is up for renewal, to encourage a requirement for phosphorus removal.

(4) Birch Hill Dam. Sediments at this project are contaminated with PCBs. NAE is involved in a multi-year study of this problem. Findings are being fully coordinated with Massachusetts and other interested agencies and private parties. Currently NAE is involved in site characterization studies leading to a risk assessment. Massachusetts and the US EPA are attempting to identify PRP’s; if any are identified, it will affect the future course of the studies.

(5) Union Village Dam. Acid mine drainage from abandoned copper mines interferes with benthic habitat and colors the river red during high runoff events. As the mines are not on Corps property, NAE has no control over them. However, when possible through programs of technical assistance to the States, NAE has studied the mine drainage problems and outlined methods to stabilize the tailings piles which cause most of the problems. NAE will continue to look for ways to encourage and assist the

owners and State to take actions to minimize acid mine drainage from the sites.

l. FY00 Reservoir WQ Management Activities. NAE's FY00 Reservoir Water Quality Management Program will be determined by the Water Quality Team in mid-winter, based on an analysis of data collected in FY99. The anticipated FY00 program will cost an estimated $272,000 and cover a range of studies. Work items will likely include (1) baseline fixed station monitoring at class III, II and I projects with conservation pools, (2) EPA priority pollutant scans at one or more projects, (3) continuation of the bathing beach and potable water quality monitoring, (4) continued investigation of the relationship between rainfall and bacteria levels at beaches, to develop better means of determining when to close and reopen swimming areas, and (5) carrying out Operation Lakewatch at one or more projects.

4. OTHER WATER QUALITY STUDIES, INVESTIGATIONS, AND DESIGNS PERFORMED IN FY99

a. Environmental Assessments. In support of Planning's Evaluation Branch, Water Management Section (WMS) prepared water quality assessments for use in preparation of Environmental Assessment reports. Barre Falls Dam in Massachusetts, Mansfield Hollow and West Thompson Lakes in Connecticut, Edward MacDowell Lake in New Hampshire, and Union Village Dam in Vermont were the projects for which reports were prepared in FY99. Projects planned for water quality assessments in FY00 are currently limited to Birch Hill Dam in Massachusetts. These assessments require current water quality data, and benefit from NAE's continuing baseline monitoring program.

b. Birch Hill PCB Studies. Sediments in certain areas within the Birch Hill Dam project area have high levels of PCBs. NAE has been studying this contamination for more than a decade in coordination with the Massachusetts Department of Environmental Protection (MADEP). In 1998 NAE and MADEP contracted with the USGS and ENSR to conduct site characterization studies which, in conjunction with previously collected data, would provide enough information to allow a risk assessment to be performed.

The USGS deployed passive samplers at various locations in the Otter and Millers Rivers. These samplers capture PCBs in the water column by diffusion across a polyethylene membrane into a hexane solution. It is a method for concentrating and measuring extremely low levels of PCBs, that does not allow direct quantification of concentrations but can be used to judge relative levels. Initial results released by the USGS at the end of September 1999 showed that an area of Otter River wetlands within the Birch Hill Dam project area appears to be a source of PCBs to the water column. PCB concentrations decrease by two orders of magnitude upstream of this area and one order of magnitude downstream. Recent sampling by ENSR, as well as results from previous studies, have shown this area to have high levels of PCBs in its sediments.

The USGS proposes to measure PCBs in the water column throughout a complete year, and to measure sediment PCB in impoundments below Birch Hill Dam to get a better understanding of PCB fluxes in the river. However, further studies are on hold pending results from MADEP's attempts to identify the PRP's. Whether a PRP can be identified will affect the course of future studies and how they will be funded.

c. Angler Surveys. In an effort to meet the mandate set forth in Executive Order 12962 requiring federal agencies to improve aquatic ecosystems for increased recreational fishing opportunities, the water quality program provided funds towards a demonstration angler survey by WES in FY98. In FY99 this program advanced to full surveys of four projects – West Thompson Lake in Connecticut, Hopkinton-Everett Lakes in New Hampshire, and Buffumville and East Brimfield Lakes in Massachusetts. Supported entirely by project funds, work was contracted to WES, who subcontracted to Pennsylvania State University. Work included distribution of comment cards to anglers and direct interviews to determine perceptions of fishing quality and desired improvements. Surveys and interviews were conducted in the winter, late spring and summer, and fall to get responses from different groups of fishers. Public perceptions of fishing quality were compared with data from State creel censuses. Reports are scheduled for January 2000, and will include two categories of recommendations – those the Corps can

implement, and those falling within the States' jurisdictions.

d. Cohasset Watershed Study. Concerned about potential threats to the quality of their water supply system, the town of Cohasset, Massachusetts requested NAE to perform a limited watershed study under the authority of the Planning Assistance to States Program. Sediment and water samples were collected to check for possible contamination from the former Hingham Annex, Wompatuck State Park hazardous waste site, Cohasset Heights Ltd. landfill, and residential areas draining into the Aaron River and Lily Pond. Results mostly showed levels of contamination within the expected range of background conditions even during storm runoff. In a report finished in FY99, NAE summarized findings and made recommendations for future monitoring by the town.

e. Naugatuck River Flow Augmentation . At the request of the Connecticut DEP, NAE agreed to make storage available at Thomaston Dam in 1999 for low flow augmentation at Thomaston Dam to alleviate water quality problems in the Naugatuck River during the upgrading of the Waterbury wastewater treatment plant (WWTP). Analysis of flows in the Naugatuck River indicated a storage of 1500 acre-feet at Thomaston Dam, in conjunction with releases from Wigwam Reservoir, could provide a reliable minimum flow of 50 cfs at the WWTP even during a repeat of the 1965 drought. If the project started storage on May 1, there was a 99 percent probability the 1500 acre-feet would be available by the beginning of June. However, to avoid canceling certain recreation activities by flooding the reservoir, Connecticut officials requested the Corps not to beginning storing water until the middle of June.

Unfortunately, the summer of 1999 turned out to be one of the driest on record with virtually no rain in June. Storage at the dam was only about 150 acre-feet, roughly a tenth of the desired volume, by the end of June when the City of Waterbury exhausted its water supply for augmentation and requested the Corps to begin releases. NAE began augmenting flows on 28 June, but there was too little storage to raise flows to the desired 120 cfs at Beacon Falls. Instead, with the agreement of all parties, Thomaston Dam released only 10 cfs above inflow, increasing flows at Beacon Falls to between 95 and 100

cfs. NAE did this to increase the amount of time augmentation flows could be made, but even at this lower rate the augmentation pool was emptied within a week.

An automatic monitor was deployed in the Thomaston Dam augmentation pool to record the effects on water quality. However, the pool was too small and maintained for too short a period to have many. There were no algal blooms or other significant changes in water quality as could have occurred with a larger pool. The monitor was retrieved after the pool was depleted in early July.

Due to the extreme low flows in the river, water quality below the Waterbury treatment plant was very poor throughout most of July and August. Low dissolved oxygen was the main problem, but odors and solids concentrations were additional concerns.

After hurricane Floyd came through in the middle of September, there was enough flow to fill the Thomaston Dam augmentation pool. However, there was enough flow in the river that augmentation from Thomaston Dam was not needed.

f. Town Brook Smelt Spawning. Due to concerns about the Town Brook local protection project's potential to affect flows in smelt-spawning areas of Town Brook, a smelt conservation team was formed in 1998. This team had members from the Corps, City of Quincy, MDC, Massachusetts Division of Marine Fisheries, and U.S. National Marine Fisheries Service. In 1999, team personnel inspected the brook before spawning began to ensure proper flows were maintained in the brook, and met regularly during the spawning season to discuss progress and issues. NAE also redesigned part of the Centre Street junction structure, a portion of the nonfederally constructed local protection project, to improve its reliability in providing sufficient flow for spawning. This redesigned structure will be constructed in the late fall or early winter of FY00.

g. Town Brook Tunnel Water Quality. The Water Quality Certificate (WQC) issued by the Massachusetts DEP for the Town Brook tunnel requires water quality sampling and reporting of results. The 4,000 foot long, deep rock tunnel is a key part of the Town Brook Local Protection

Project, and it has sophisticated water quality controls built into it. A relief tunnel, it only receives major inflows during storm events. Between storms, seawater can enter the tunnel through the outlet twice a day during high tides. The resulting mix of urban storm runoff with saltwater in an enclosed tunnel with minimal flushing (between storms) could easily lead to anaerobic conditions and the generation of hydrogen sulfide. To prevent this, the tunnel has a system of flushing pipes connected by pumps to cascade aerators at the tunnel entrance and exit. In addition, air compressors are connected to diffusers to supply additional dissolved oxygen (DO) in an emergency. Automatic water quality monitors (AWQM) measuring DO, pH, temperature, and conductivity are connected to these pumps. Every day at a little past midnight, the pumps come on to send water to the AWQM. If the DO is above 6.0 ppm, the system shuts down; however, if it is less than that, the pumps continue to run water over the aeration cascades for an hour when another reading is taken. This reading must be at least 6.5 ppm; otherwise, pumping and aeration continue with hourly checks until 6.5 ppm is achieved. This system can be remotely accessed by computer, and data can be retrieved or the system turned on or off at any time. Each month the previous month’s data are retrieved and sent to the DEP.

Monthly data from the tunnel AWQM shows generally good to excellent DO conditions. Out of the first 365 days of operation, the DO was below 6.0 on only 13 days, rarely below 5.0 and never below 4.73 ppm. Storm inflows are obvious in this monitor record because the conductivity goes down indicating saltwater is being flushed out with fresh, and the DO goes up.

In the spring of 1999, a filter on the line to the AWQM began clogging with the result that reliable DO measurements could not be obtained. Consequently, NAE began running the pumps at the inflow station continuously until a contract could be executed for recalibration and maintenance of the AWQM. Using a hand-held AWQM, WMS bleed water from the lines through valves installed for that purpose and repeatedly checked that the pumps were mixing the tunnel water and maintaining a high DO. These checks showed that the system worked very well.

After the AWQM is serviced and the automatic system is functioning reliably again, NAE will resume sending AWQM data to the DEP until the tunnel is turned over to the MDC. However, even after the transfer occurs, NAE will use the computer connection to keep an eye on water quality conditions.

h. Parker Pond. Parker Pond in north central Massachusetts is heavily filled in with sediment and suffers from severe aquatic weed problems, especially the nonnative weed fanwort. The combination has greatly restricts habitat for aquatic animals, especially fish. Under authority in section 206 of the 1999 Water Resources Development Act, NAE is studying means to improve the pond. Initial results based on past studies and water quality and fish sampling by the Corps indicate that selective dredging to deepen the pond and remove aquatic plants and nutrient-laden sediments would improve the lake's biodiversity including the return of several fish species. A final report is scheduled for FY00.

i. Turner Reservoir. At the request of the City of East Providence, Rhode Island, the Corps began preliminary investigations of the feasibility of using Turner Reservoir for public water supply or more intensive recreation. The water's appearance is not attractive, with large amounts of aquatic weeds and numbers of waterfowl. However, Corps investigations, including water quality and fish sampling, did not find any water quality problems that would prohibit using Turner Reservoir for recreation including swimming, or for public water supply. A final report by the Corps is scheduled for FY00.

j. Rhode Island Salt Pond Restoration. In FY98 NAE completed a reconnaissance study to restore eelgrass in certain salt ponds along the Rhode Island coast. Siltation and channel restrictions have reduced tidal inflows, and this has reduced the extent of eelgrass beds, which are important nursery areas for many species. Saltwater inflows would be increased by selective dredging. In FY99, NAE worked on the feasibility study, which is scheduled to be completed in FY00.

k. Providence River Dredging Studies. Water Management Section is studying disposal locations for dredged material from the Providence River in Rhode

Island. This involves the use of complex computer programs to model sediment movement, and physical studies of sediment characteristics. Because of the size and complexity of this study, much of it is being subcontracted including some of the computer modeling to WES, current measurements to ENSR, and erosion flume studies to Georgia Tech.

l. Superfund Site Studies. Water quality concerns are a major part of Superfund projects. Contaminated soil and groundwater are the most commonly encountered problems. Because of ground water mobility, water quality can be both the most important and complicated aspect of cleanups. In FY99 WMS was involved in long-term monitoring studies at Baird and McGuire, cleanup of the continuing source areas at the Nyanza Chemical Company sites in Massachusetts, review of studies of PCBs in the Housatonic River, Connecticut, and sample collection oversight in Hoboken, New Jersey. WMS was also involved in groundwater and sediment sampling as part of long-term monitoring of cleanups at former military sites including Sudbury and Devens in Massachusetts, and Quonsett Point in Rhode Island.

5. TRAINING AND ATTENDANCE AT WATER QUALITY MEETINGS AND CONFERENCES

In June 1999 a contractor from GIS\Key came to NAE to give instruction in the use of their software for water quality data storage and retrieval; Ms. McNally, Ms. Miller, and Mr. Barker attended.

In December, WMS members attended annual hazardous waste operations and emergency response refresher training.

6. WATER QUALITY RESEARCH/GUIDANCE NEEDS

Listed below are areas where NAE's water quality programs and studies could benefit from research or guidance from Corps Labs or OCE.

- Guidance in conducting studies of the relationship between rainfall and beach bacteria levels would be very

useful. Although the final result will be uniquely project specific, methods for conducting these studies would likely be broadly applicable.

- Environmental studies at NAE will increasingly require use of sophisticated PC-based water quality models such as CEQUAL.ICM. Training and technical assistance will be required in the use of these models. It is important that these models are made as user-friendly as possible.

- The LTFATE model developed by WES to determine the long term fate of contaminants in dredged material is an example of an important program that needs improvement. The “user friendly” version was found to have relatively few options for handling output. Changes to allow control of printout and manipulation of files would be extremely useful.

7. USE OF CORPS LABS IN FY99

NAE contracted with the Corps Waterways Experiment Station (WES) in Vicksburg, Mississippi for a number of tasks connected with the Providence River dredging study. The Hydraulics Lab ran computer models including ADCIRC, STFATE, and LTFATE. The WES Geotechnical Lab ran centrifuge tests on sediments to determine consolidation rates. WES also conducted angler surveys through its subcontractor, Penn State.

8. USE OF CONTRACT LABS IN FY99

In addition to the laboratories listed in paragraph 3b used to perform analyses as part of the regular water quality program, NAE contracted with private labs for specific tasks. Georgia Tech was contracted to run flume studies on erosion rates for Providence River sediments, and NAE contracted with Battelle to collect the sediment samples.

9. DISTRIBUTION LIST

a. Corps of Engineers

North Atlantic Division
District Engineer
Chief, Engineering/Planning Division
Chief, Construction/Operations Division
Chief, Public Affairs Office
Upper Connecticut River Basin Manager
Lower Connecticut River Basin Manager
Thames River Basin Manager
Naugatuck River Basin Manager
Merrimack River Basin Manager
Chief, Geotechnical and Water Management Branch
Chief, Operations Technical Services Branch
Chief, Evaluation Branch
Mr. Hubbard
Mr. Williams
Mr. Trinchero
Mr. Barker
Mr. Levitt
Mr. Hays

b. Non-Corps

Secretary
Executive Office of Environmental Affairs
Saltonstall Building
100 Cambridge St
Boston, MA 02202

Mr. Jeffrey H. Taylor, Director
Office of State Planning
2-1/2 Beacon Street
Concord, NH 03301-4497

Mr. John Kassel, Secretary
Agency of Natural Resources
103 South Main Street
Waterbury, VT 05676

Mr. Eban D. Richert, Director
State Planning Office
State House Station #38
184 State Street
Augusta, ME 04333-0001

Mr. Andrew McCloud, Acting Director
Department of Environmental Management
235 Promenade Street
Providence, RI 02908

Mr. Arthur J. Rocque, Jr., Commissioner
Department of Environmental Protection
79 Elm Street
Hartford, Connecticut 06106

Director
Water Management Branch
U.S. Environmental Protection Agency
J.F. Kennedy Federal Building
Boston, Massachusetts 02203

Mr. Thomas Willard
Vermont Agency of Natural Resources
Department of Environmental Conservation
Montpelier, Vermont 05602

Mr. Russell Isaac
Massachusetts Division of Water Pollution Control
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Director and Chief Engineer
Massachusetts Division of Water Resources
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Chairman
New Hampshire Department of Environmental Services
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Commissioner
Department of Environmental Protection
State Office Building
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Mr. Karl L. Jurenthuff
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103 South Main Street
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Director
State of New Hampshire Fish and Game Department
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Ms. Nancy Brown
Connecticut River Watershed Council, Inc.
One Ferry Street
Easthampton, MA 01027

APPENDIX A

EXPLANATION OF NAE RESERVOIR PROJECT WATER QUALITY CLASSIFICATION SYSTEM

EXPLANATION OF NAE RESERVOIR PROJECT WATER QUALITY CLASSIFICATION SYSTEM

The 31 projects maintained and operated by NAE are grouped into three categories, based on past and present water quality conditions. Five factors are used in the assignment of classes: (1) statements of project conditions in past NAE Annual Water Quality Reports, (2) State Water Quality reports, including information on upstream watershed activity, (3) identifiable changes between inflow and discharge water quality, (4) frequency of violation of water quality criteria, and (5) existence of a conservation pool.

Simply stated, class I projects have high water quality, class II projects have minor or suspected water quality problems, and class III projects experience continuing water quality problems. Low level, fixed station monitoring is applied at class I and class II projects, and high level monitoring is applied at class III projects. Class III projects have the highest priority for intensive surveys or other special studies, and class II projects have a low priority. No intensive surveys are planned for class I projects.

APPENDIX B

STATE WATER QUALITY CLASSIFICATIONS
NAE PROJECTS

STATE WATER QUALITY CLASSIFICATIONS OF NAE RESERVOIR PROJECTS

Project	State	Classification
Ball Mountain Lake	VT	B
Barre Falls Dam	MA	A
Birch Hill Dam	MA	B
Black Rock Lake	CT	B
Blackwater Dam	NH	B
Buffumville Lake	MA	B
Colebrook River Lake*	MA	A
Colebrook River Lake	CT	AA
Conant Brook Dam	MA	A
East Brimfield Lake	MA	B
Edward MacDowell Lake	NH	B
Everett Lake	NH	B
Franklin; Falls Dam	NH	B
Hancock Brook Lake	CT	B
Hodges Village Dam	MA	B
Hop Brook Lake	CT	B
Hopkinton Lake	NH	B
Knightville Dam	MA	B
Littleville Lake	MA	A
Mansfield Hollow Lake	CT	AA
Northfield Brook Lake	CT	B
North Hartland Lake	VT	B
North Springfield Lake	VT	B
Otter Brook Lake	NH	B
Surry Mountain Lake	NH	B
Thomaston Dam	CT	B
Lead Mine Brook	CT	A
Townshend Lake	VT	B
Tully Lake	MA	B
Union Village Dam	VT	B
West Hill Dam	MA	B
West Thompson Lake	CT	C
Westville Lake	MA	B

*Colebrook straddles the Massachusetts/Connecticut border.

APPENDIX C

RESERVOIR WATER QUALITY CONTROL MANAGEMENT REPORTS
NEW ENGLAND DIVISION

Reservoir Water Quality Control Management Reports
New England Division
(Prepared through FY99)

Project	Report and Date
Connecticut.	
Black Rock Lake	Black Rock Lake Water Quality Evaluation, June 1983.
Colebrook River Lake	Colebrook River Lake Water Quality Evaluation, June 1983. Colebrook River Lake Dissolved Gas Supersaturation Study, August 1984. Colebrook River Lake Priority Pollutant Scan, September 1997.
Hancock Brook Lake	Hancock Brook Lake Water Quality Evaluation, June 1983. Hancock Brook Lake comprehensive Fisheries and Water Quality Investigation (1991 - 1992), Plymouth, Connecticut.
Hop Brook Lake	Hop Brook Lake Water Quality Evaluation, April 1983. Hop Brook Lake Water Quality Evaluation Update, August 1984. Hop Brook Lake Nutrient Balance Study, August 1987. Hop Brook Lake Fisheries Assessment, April 1987. Hop Brook Lake Destratification Study, August 1985. Hop Brook Lake Summary of Limited Biological Survey, May 1981. Hop Brook Lake Close Interval Sampling, Sediment and Algal Progression Study, May 1990. Hop Brook Lake Water Quality Study (Interim Report), June 1990. Hop Brook Lake Water Quality Study (Interim Report), April 1993. Hop Brook Lake, Connecticut, Priority Pollutant Scan, August 1993.
Mansfield Hollow Lake	Mansfield Hollow Lake Water Quality Evaluation, June 1983. Mansfield Hollow Lake Water Quality Evaluation, July 1988.
Northfield Brook Lake	Northfield Brook Lake Water Quality Evaluation, January 1983. Priority Pollutant Scan of an Unnamed Brook at Northfield Brook Lake July 1992
Thomaston Dam	Thomaston Dam Water Quality Evaluation, April 1983. Brown Trout Habitat Suitability at Thomaston Dam, Connecticut, February 1987. Limnological Survey at Thomaston Dam, Connecticut, March 1987. Thomaston Dam, Water Quality Evaluation, June 1991. Thomaston Dam, Connecticut, Priority Pollutant Scan, August 1994.

Connecticut. (cont.)

West Thompson Lake	A Biological and Chemical Survey of Algal Blooms at West Thompson Lake, Connecticut, August 1979. West Thompson Lake Water Quality Evaluation, April 1983. West Thompson Lake Water Quality Evaluation Update, June 1984. Final Report on the West Thompson Lake Algae Control Study, June 1986. West Thompson Lake Algal Progression Study, June-July 1988; Jan. 1989. West Thompson Lake Algal Progression Study, June-Sept. 1992; Feb. 1995. West Thompson Lake, Connecticut, Priority Pollutant Scan, December 1994.

Massachusetts.

Barre Falls Dam	Barre Falls Dam Water Quality Evaluation, June 1983. Barre Falls Dam, Massachusetts, Priority Pollutant Scan, January 1995.
Birch Hill Dam	Birch Hill Dam Water Quality Evaluation, April 1983. Birch Hill Dam Water Quality Evaluation, July 1987. Birch Hill Dam, Priority Pollutant Scan, Interim Report, July 1988. Birch Hill Reservoir PCB Investigation, July 1989. Birch Hill Reservoir PCB Investigation, September 1990. Birch Hill Reservoir PCB Investigation, Phase I, October 1991. Birch Hill Reservoir PCB Study, March 1992
Buffumville Lake	Buffumville Lake Water Quality Evaluation, January 1983. Buffumville Lake Water Quality Evaluation Update, May 1984. Buffumville Lake Water Quality Evaluation, August 1985. General Limnological Survey, Buffumville Lake, 1985.
Charles River NVSP	Charles River NVSP Water Quality Assessment, June 1987.
Conant Brook Dam	Conant Brook Dam Water Quality Evaluation, June 1983.
East Brimfield Lake	General Limnological Survey, The East Brimfield Project/Lake. 1982. East Brimfield Lake Water Quality Evaluation, January 1983. East Brimfield Lake Water Quality Evaluation Update, September 1984. East Brimfield Lake - Iron, July, 1996.
Hodges Village Dam	Hodges Village Dam Water Quality Evaluation, April 1983.
Knightville Dam	Knightville Dam Water Quality Evaluation, June 1983. Knightville Dam Fishery Assessment, Huntington, Massachusetts, May 1989

Littleville Lake	Littleville Lake Water Quality Evaluation, January 1983. Fisheries Assessment, Littleville Lake, 1987.

Massachusetts. (cont.)

Tully Lake	Tully Lake Water Quality Evaluation, June 1983. Tully Lake Evaluation of Effects of Flood Control Project Operations on Water Quality, September 1984. Tully Lake Fisheries Investigation (June-August 1993)
West Hill Dam	West Hill Dam Water Quality Evaluation, April 1983. West Hill Dam Priority Pollutant Scan, April 1999
Westville Lake	Westville Lake Water Quality Evaluation, January 1983.

French River Projects Priority Pollutant Scan, January 1999

New Hampshire.

Blackwater Dam	Blackwater Dam Water Quality Evaluation, June 1983.
Edw. MacDowell Lake	Edw. MacDowell Dam Water Quality Evaluation, January 1983.
Everett Lake	Everett Lake Water Quality Evaluation, September 1982. Everett Lake Water Quality Evaluation, January 1983.
Franklin Falls Dam	Franklin Falls Dam Water Quality Evaluation, April 1983. Franklin Falls Dam Water Quality Evaluation, April 1984. General Limnological Survey, Franklin Falls Dam, 1984.
Hopkinton Lake	Hopkinton Lake Water Quality Evaluation, September 1982. Hopkinton Lake Water Quality Evaluation, April 1983. Elm Brook Pool Water Quality Evaluation, September 1982. Hopkinton Lake, Priority Pollutant Scan, June 1988. Hopkinton Lake, An Assessment of the Fishery, November 1995.
Otter Brook Lake	Otter Brook Lake Water Quality Evaluation, April 1983. Otter Brook Lake Evaluation of Effects of Flood Control Project Operations on Water Quality, May 1984. Otter Brook Lake, New Hampshire Fisheries Assessment, November 1987. Otter Brook Lake, New Hampshire, Priority Pollutant Scan, February 1993.
Surry Mountain Lake	Surry Mountain Lake Water Quality Evaluation, June 1983.

Surry Mountain Lake, New Hampshire Fisheries Assessment, Nov. 1987.

Vermont.

Ball Mountain Lake	Ball Mountain Lake Water Quality Evaluation, August 1982. Ball Mountain Lake Water Quality Evaluation, June 1983. Ball Mountain Lake Water Quality Evaluation, September 1987.
North Hartland Lake	North Hartland Lake Water Quality Evaluation, August 1982. North Hartland Lake Water Quality Evaluation, January 1983. North Hartland Lake Water Quality Evaluation, September 1986. Smallmouth and Largemouth Bass Suitability at North Hartland Lake, Vermont, November 1987.
No. Springfield Lake	North Springfield Lake Water Quality Evaluation, August 1982. North Springfield Lake Water Quality Evaluation, April 1983. Stoughton Pond at North Springfield Reservoir Water Quality Evaluation, August 1982. North Springfield Lake Fishery Assessment, North Springfield and Weathersfield, Vermont, May 1989. North Springfield Lake Fisheries Investigation, and Status of Largemouth Bass Fishery in 1991, North Springfield and Weathersfield, Vermont, May 1996.
Townshend Lake	Townshend Lake Water Quality Evaluation, September 1982. Townshend Lake Water Quality Evaluation, June 1983. Atlantic Salmon Suitability at Townshend, Vermont, November 1987.
Union Village Dam Preliminary	The Effects of Mine Drainage at the Union Village Project, (A Biological and Chemical Survey), March 1980. Union Village Dam Water Quality Evaluation, January 1983. Union Village Dam Water Quality Evaluation Update, August 1984. Union Village Dam Water Quality Evaluation, September 1989.

Vermont Lakes Priority Pollutant Scan, June 1998